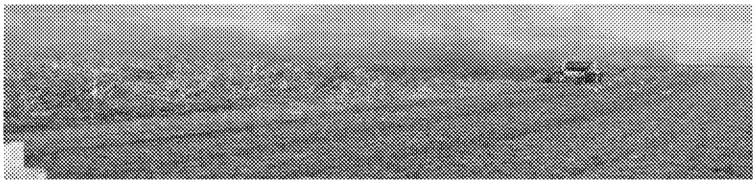

US Open Burning of Agricultural Residues

Why is it Important?

Each year, over 295 million acres of cropland are harvested in the United States. About 3% of this land (8.9 million acres) is burned each year (USDA-NRCS, 1999). Most cropland burning occurs in the Southeast, Great Plains, and Pacific Northwest, and is done to remove residues to facilitate planting, control pests and weeds, and provide ash fertilization. Sugarcane, wheat, and rice residues account for about 70% all crop residue burning and emissions. Crop-residue burning is mainly done in spring (April to June) and fall (Oct to Dec), with some summer (July to Sept) burning of Kentucky bluegrass, and winter (Jan to March) burning of sugarcane (McCarty, 2011).

Although there are valid reasons for burning, especially to control fungi, viruses, bacteria, and unwanted plant seeds as well as its low cost, this open burning causes hazardous air pollution. Smoke from crop burning can be transported over large distances and contains many pollutants and greenhouse gases. Of particular concern is fine-particle ($PM_{2.5}$) pollution because exposure, even short term, to $PM_{2.5}$ can increase the incidence of respiratory illnesses and asthma attacks, and has been linked to heart disease.

In addition, black carbon (BC) emitted as $PM_{2.5}$ from agricultural burning has climate impacts. In particular, deposition of BC on snow and ice causes radiative (or climate) forcing, which is the difference between insolation (sunlight) absorbed by the Earth and energy radiated back to space. The dark BC aerosols change the reflectivity of the surface, leading to warming and ice melt.

Other important adverse effects of burning include destruction of humus (organic matter) and soil structure, and of a potential resource – the residues. In addition, burning leaves land exposed to erosion and is not sustainable because it typically takes years for soil to regain its fertility.

The focus of much of this action list is on Cropland Burning. As well as cropland, agricultural land (on which burning may also occur) includes rangelands, pasture, and other lands on which livestock are produced

What Types of Crops are Burned?

This information is drawn from the recommendations on USDA Agricultural Burning Policy by the US Department of Agriculture Air Quality Task Force (USDA-NRCS, 1999).

Sugarcane

Sugarcane is burned to destroy the 30% residue portion of the plant. Until recently, there was no profitable or effective way to manage this residue by mechanical means. Currently, almost all of the

890,000 acres of sugarcane grown in Florida, Louisiana, Hawaii, and Texas are burned. However, in Brazil and Australia, some sugar growers cut leafy parts of sugar cane and use it to mulch fields. Another promising option is to use the leafy cuttings as biofuel in plants that have pollution-control equipment

Deciduous Fruits, Nuts, Grapes, Berries

Crops grown on trees, vines, and bushes require pruning after crop harvesting. Most of this residue can be chopped or shredded; incorporating it into the soil can damage shallow root systems. In the US, about 5% of the 4.7 million acres of these crops, including orchards, are burned each year (Odom, 1997).

Rice

Each year, about 20% of the 3.1 million acres of rice grown in Arkansas, Louisiana, California, Texas, Mississippi, and Missouri is burned. However, burning of rice straw after harvest is declining due to air-quality concerns and new techniques to incorporate rice straw into the soil.

The USDA projected world rice production for 2013-14 at about 475 million metric tons, an increase of over 4 million metric tons from the previous year around the world (USDA, 2014). Of this, China produced about 204 million metric tons, followed by India (153 million metric tons) and Indonesia (69 million metric tons). The Food and Agriculture Organization of the UN (FAO) (2014) reported that China is the largest global producer of rice straw.

Although the US is incorporating more rice straw into soil, many countries are finding many uses for rice straw and are rethinking past burning practices. (see Rice Straw Burning below.)

Small Grains

In the US, over 70 million acres are in small grain production. Each year, about 7 to 8 million acres of small grain stubble are burned, but use of alternative practices is increasing, including growing short-stem varieties, minimum tillage, and removal (e.g., baling of excess straw).

Grass Seed

Each year in the US, about 400,000 acres of grass seed fields are burned, mostly in the Pacific Northwest. Burning of grass fields often occurs in late summer and fall under smoke management programs. Alternatives to burning include residue removal and shorter crop cycles, as well as breeding programs to develop new varieties that maintain yields without burning.

Who Controls US Cropland Burning?

In the US, Federal (e.g., US Department of Agriculture (USDA), Forest Service) and State environmental and land agencies, recognize the role of fire in agriculture when creating policies related to air-pollution emissions. Few of these policies are aimed at reducing the use of agricultural burning. Instead, most states address agricultural burning in Smoke Management Programs and Plans, through their burn-permitting process, and open-burning laws (University of Arkansas, 2015).

USDA Role

USDA Agricultural Burning Policy recommends that States and Tribes adopt a Smoke Management Program (SMP) which establishes conditions (time of day and year, meteorological conditions, safety parameters, type of burn, maximum number of acres, etc.) under which agricultural burning can occur (USDA-NRCS, 1999).

For areas where agricultural burning contributes to violations of the National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) or to visibility impairment in the 156 mandatory Class I Federal areas (national parks and wilderness areas), USDA recommends that the SMP include a process for granting approval for agricultural burns and establishing criteria for burn/no-burn decisions. The agency also recommends that permit requirements for these areas include real-time meteorological assessment for burn decisions, air-quality monitoring, public notification, and enforcement requirements.

USDA policy recommends modeling downwind PM levels, determining emission factors, evaluating techniques to reduce emissions, and developing alternatives to agricultural burning.

US EPA Role

Generally, the US EPA does not directly regulate agricultural burning within a State or on Indian lands. EPA's authority is to enforce requirements of the Clean Air Act that requires States and Tribes to attain and maintain the NAAQS for "criteria pollutants" (CO, Pb, NO_2, PM, ozone, and SO_2). EPA sets NAAQS to protect public health and designates areas that meet the specified standard as “attainment areas” and those that don't meet the standard as “nonattainment areas.” EPA also sets visibility standards to control regional haze in the mandatory Class I Federal Areas.

States in $PM_{2.5}$ nonattainment areas must develop plans to return to attainment. If plans include controls on open burning, state air agencies work with EPA to develop regulations and/or a Smoke Management Programs to control those emissions in the airshed. These rules or plans in turn are submitted to EPA for approval.

As well as working with individual states, EPA provides financial, policy and technical support for State and Tribal SMPs, including developing guidance documents, technical tools for modeling and forecasting, and conducting annual Smoke Management meetings.

State and Municipality Role

In addition to the Federal government, States and many cities and counties regulate air quality through local legislation. The Clean Air Act allows states (i.e., state environmental agencies) to adopt standards or requirements that are more stringent than federal requirements.

Most State and municipal laws seek to control open burning of trash and debris, but provide exemptions for agricultural burning, forest management, and outside cooking. According to a report by the University of Arkansas (2015), State agricultural field-burning policies differ in regard to:

- Permit requirements
- Permitting authority (state versus local)
- How permits are issued (online versus telephone call versus in- person)
- Time of year burning is allowed
- Time of day burning is allowed (day versus night hours)
- Region- wide acreage allocation on burn days
- Time of year burning is prohibited
- Definition of "agricultural" burning
- Materials allowed to prime fires
- Zoning regulations – agricultural burning only allowed on property zoned agricultural;
- Burn ban exemptions (included or excluded)
- Notification requirements of local authorities or neighbors
- Data reporting requirements

Examples of State Policies (University of Arkansas, 2015)

- **Alabama** (Jefferson County): Prohibits agricultural burning from May 1- Oct. 31; rest of year need written authorization.
- **Alaska**: Burning 40 acres or more annually requires Alaska Department of Environmental Conservation approval.
- **California**: 1991 Rice Straw Burning Reduction Act established Statewide cap on rice field acreage that could be burned annually, and limited burned acreage to 25% of an individual grower's planted acreage. (For short discussion of issues implementing this Act, see University of Arkansas, 2015.) Many farmers now use alternatives to burning, such as winter flooding and incorporation of straw back into ground.
- **Connecticut** (town of Wethersfield): agricultural burning can only be done on properties designated as "farmland" by the Assessor's office.
- **Idaho**: Within 24 hours of burning, burner is required to report to Department of Environmental Quality (DEQ) the actual number and location of acres burned and size of remaining materials if burn not completed.
- **Massachusetts**: No State burning permit required, but needs permission of local fire chief.
- **Mississippi**: Agricultural burning prohibited in four counties when an Ozone
- Action Day is declared.
- **Nebraska**: Only need to notify local fire chief.
- **Ohio**: If agricultural burning occurs within an area inside a city or village or within a mile of a small city, burners need to provide written notice to Ohio EPA at least 10 days before burning.
- **Oklahoma**: Agricultural burns exempted from burn bans if approved by state officials.
- **Oregon:** Regulates burning of grass-seed fields in the Willamette Valley (regulations also in place for Jefferson and Union Counties). State prohibits stacked or piled straw and propane flaming methods
- **Oregon** (city of Gresham): Can burn only if more than 51% of a person's
- income is derived from the property and property must be more than 5 acres.
- **Tennessee**: Priming materials used to facilitate burning limited to #1 or #2 grade fuel oils, wood waste, or other ignition devices approved by the Technical Secretary of Air Pollution.
- **Virginia**: Allows burning to destroy strings and plastic ground cover in a field being used to grow staked tomatoes.

- **Washington:** Created Agricultural Burning Practices and Research Task Force to develop Best Management Practices (BMPs) to reduce air emissions, determine permit fees, and research alternatives to field burning. State enacted moratorium on burning Kentucky bluegrass residue.

Components of a Smoke Management Program

A Smoke Management Program spells out the information needed for allowable burning activities to occur. Information requirements generally includes meteorological, fuel conditions, predicted fire behavior, smoke movement and atmospheric dispersal.

Despite differences in State agricultural burning policies, there is general agreement on the basic components of a "smoke management" or "burn plan." These components include:

- **Authorization to Burn** – Process for granting approval to manage Rx (prescribed) fire; could include burn permits
- **Minimizing Air Pollutant Emissions** – Follow appropriate emission reduction techniques or evaluate alternatives to fire
- **Smoke Management Components** – includes actions for minimizing emissions, approaches for evaluating smoke dispersion, procedures for notifying public and reducing exposure, and air-quality monitoring
- **Public Education and Awareness** – criteria for issuing health advisories and procedures for notifying public
- **Surveillance and Enforcement** – procedures to ensure compliance with terms of SMP
- **Program Evaluation** – periodic review of SMP effectiveness and program revision

Coordination between Stakeholders

Coordination between stakeholders is essential for a successful Smoke Management Program. Stakeholders include the federal regulators (USDA and US EPA), State and local land management agencies (Agriculture, Forestry), State and local air quality agencies, and the regulated community (e.g., farmers, residents). These stakeholders discuss and have input on all aspects of the Smoke Management Program to better control burning, minimize air-quality impacts, and to manage land resources.

Examples of Stakeholder Coordination:

- Oregon - [HYPERLINK "http://www.oregon.gov/ODF/Board/Pages/SMAC.aspx"]
- Montana-Idaho Airshed group - [HYPERLINK "https://mi.airshedgroup.org/"]

Air-Quality Monitoring and Forecasting

The ability to monitor real-time pollution levels and to forecast air quality provides is essential for a regulating agency to make decisions about when and where to allow burning to occur without creating unacceptably high levels of air pollution (e.g., 75-80% of the $PM_{2.5}$ NAAQS).

Note that meteorology has a major effect on air pollution, with variables such as wind speed, temperature and precipitation affecting dilution, chemical reaction rates and the removal of pollutants through rain-out, respectively.

Monitoring

Official air-quality data is derived from a network of ambient air-quality monitors for $PM_{2.5}$ and other pollutants. Short-term or portable monitors can be used to supplement data from the official monitors. However, inexpensive portable air sensors should only be used as a screening tool for local air quality. In the US, official (AirNow) monitors are built and operated according to rigorous air-monitoring regulations and provide high-quality data. Most low-cost sensors currently do not meet these data-quality standards.

[HYPERLINK "https://www.epa.gov/outdoor-air-quality-data"]
https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors

Forecasting

National air-quality forecasts:
The National Oceanic and Atmospheric Administration (NOAA), in partnership with US EPA, issues daily and hourly air-quality forecasts.
[HYPERLINK "https://www.airnow.gov"]
[HYPERLINK "http://airquality.weather.gov"]

> *Regional Climate Centers*: NOAA manages the RCC Program, which consists of six regional centers in the US:
> [HYPERLINK "https://www.ncdc.noaa.gov/customer-support/partnerships/regional-climate-centers"]

Regional air-quality forecasts

AIRPACT: Air Information Report for Public Access and Community Tracking
Developed by US EPA Region 10, Washington Department of Ecology, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, and the Puget Sound Clean Air Agency. This computer system provides air-quality forecasting for the Pacific Northwest (Idaho, Oregon, and Washington). It provides $PM_{2.5}$ modeling predictions for up to three days for three states. AIRPACT uses the EPA model called the Community Model for Air Quality (CMAQ), which calculates air quality by treating a region as a 3-dimensional grid of cells. Thus, AIRPACT treats the Northwest region as a gridded volume of 95 cells by 95 cells, in 21 vertical layers.

AIRPACT calculates pollutant emissions using spatial databases of land use, traffic volumes, industrial emissions and natural emissions from vegetation and soils, adjusted by date, time of day and predicted temperature and solar (uv) light intensity.
[HYPERLINK "http://lar.wsu.edu/airpact/"]

Smoke Models

BlueSky ([HYPERLINK "https://www.airfire.org"]): This modeling framework links independent models of fire information, fuel loading, fire consumption, fire emissions, and smoke dispersion, and provides:

Fuels information from fuel maps

- Calculation of total and hourly fire consumption based on fuel loadings and weather information
- Calculation of speciated emissions (such as CO2 or PM2.5) from a fire
- Calculation of vertical plume profiles produced by a fire
- Calculation of likely trajectories of smoke parcels given off by a fire
- Calculation of downstream smoke concentrations

FireWork ([HYPERLINK "https://weather.gc.ca/firework"]): This Canadian air-quality prediction system, which operates from early April to late October shows how smoke from wildfires is expected to move across North America over the next 48 hours.

- [HYPERLINK "https://weather.gc.ca/firework/firework_anim_e.html?type=em&utc=00"]: smoke animations that predict how wildfire smoke is expected to spread hour by hour for the next 48 hours.
- [HYPERLINK "http://www.ec.gc.ca/cas-aqhi/default.asp?lang=En&n=63B57543-1"]: Effects of wildfire smoke on your health, actions you can take to protect yourself

Environment and Climate Change Canada ([HYPERLINK "https://www.canada.ca/en/services/environment.html"]) issues air-quality alerts when smoke concentrations are expected to be high.

Meteorology

Weather prediction

WRF ([HYPERLINK "http://www2.mmm.ucar.edu/wrf/users"]): The Weather Research and Forecasting model is a weather prediction system designed for atmospheric research and forecasting applications with over 39,000 registered users in more than 160 countries. In the US, the National Centers for Environmental Prediction (NCEP) employs WRF in support of the National Weather Service.

WRF capabilities include prediction of air chemistry, hydrology, wildland fires, hurricanes, and regional climate. WRF produces atmospheric simulations. One of the many ways in which the model has been used is to simulate emissions and transport of smoke from wildfires. HRRR-Smoke uses the WRF Model coupled with Chemistry (WRF-Chem). [HYPERLINK "https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke"].

Wind erosion potential

NRCS/Agricultural Research Service (ARS) Wind Erosion Prediction System (WEPS) is the primary model used by USDA to estimate wind erosion potential. Users can specify soil surface characteristics and management options. WEPS also has the capability to model crop growth and include cover crops or perennial vegetation (and barriers). The model delivers estimates of total soil loss as well as PM_{10} emissions from a specified land area. [HYPERLINK "https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/tools/weps/software/?cid=nrcs144p2_080196"]

Public Notification

Agencies responsible for approving burning activities should have a plan for notifying and interacting with communities impacted by burning. Such a plan might include:

- Identifying communities at risk (e.g., by using satellite-based methods)
- Developing public-health messages on health effects of exposure to smoke and actions that the public can take to limit exposure. (e.g., PSAs, social-media). Messages/Actions may include:
    - Use simple visibility index to help people determine PM levels (e.g., Oregon's 5-3-1 Index: visibility >5 miles good, under 1 mile unhealthy http://www.oregon.gov/deq/aq/Pages/Wildfires-Visibility.aspx)
    - Avoid activities that increase indoor or outdoor pollution (e.g., fireplaces, cook stoves, smoking, painting, diesel/gasoline equipment)
    - Reduce or delay outdoor physical activities
    - Do not rely on dust masks. Paper "comfort" or "dust" masks trap large particles, but do *not* provide protection from $PM_{2.5}$. Need HEPA Filters
    - Consider evacuating from path of fires

In addition, the agency with primary responsibility for burning should inform the public about burning activities through a daily website posting of the following:

- Identify if a given day is a burn or no-burn day
- Identify the location and number of acres permitted to be burned
- Provide meteorological conditions and any real-time ambient air-quality monitoring data
- Host a toll-free number for information requests
- Deliver an email service for people to receive updates regarding burning of crop residues and to file comments and complaints

Alternatives to Burning

As described above, the US currently focuses on Smoke Management Programs to control air-pollution and exposure problems related to agricultural burning. These SMPs establish conditions (time of day and year, meteorological conditions, safety parameters, type of burn, maximum number of acres, etc.) under which agricultural burning can occur. In the US, alternatives to burning are still in the early stages of development and implementation and include:

- Tilling practices
- No-till practices
    - This is a type of soil conservation farming that prepares land for farming without mechanically disturbing the soil. The previous year's crop residue is chopped and left on the topsoil. A no-till planter then punctures the ground to inserts a seed. Herbicides generally are applied to the land before and after planting (Staropoli, 2016).

- Residue removal
    - Bedding
    - Straw Board
    - Biomass Fuels
    - Composting
    - Chemical treatments

However, most alternatives focus on tilling practices that allow for future planting without the need to burn the prior season's crop. These practices also help reduce soil loss and wind-blown dust.

Alternatives to Rice-Straw Burning

US example: California

Rice fields in the Sacramento Valley of California were traditionally burned after harvest to dispose of straw and to control disease and pests. The rice industry worked with the State Legislature to reduce rice-straw burning between 1990 and 2000. This agreement has reduced annual acreages burned by 90 percent.

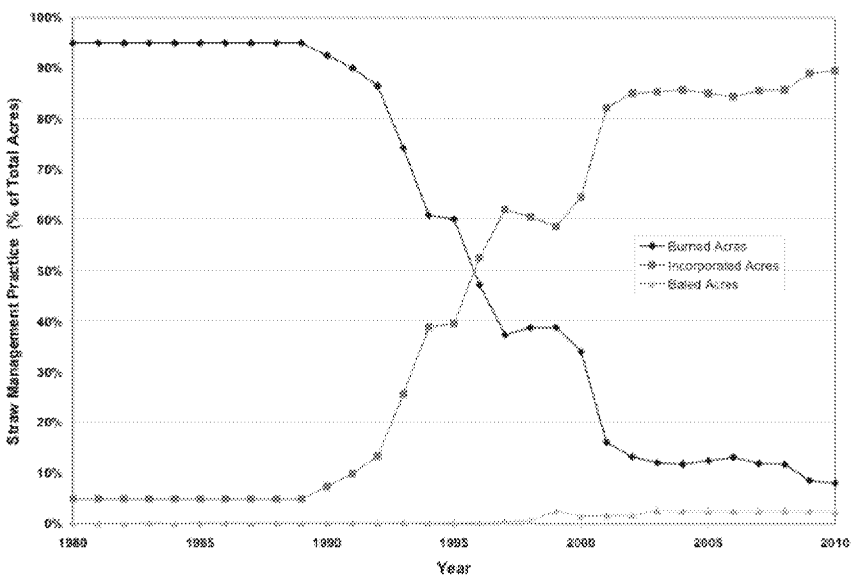

Figure 4. Straw Management Practices in California Rice, 1980-2010

Source: [HYPERLINK "http://calrice.org/pdf/publications/documents/Sustainability+Report.pdf"]

Rice growers now have 3 primary ways to manage straw:

- Incorporation of straw into soil coupled with active winter flooding
- Straw incorporation without active winter flooding
- Harvesting rice straw for use in other industries

Sacramento Valley Smoke Management Program: network of about 14 weather-monitoring stations owned/operated by CA rice industry. Data is shared with regional air officials and used to determine how Sacramento Valley agricultural burning is regulated to minimize smoke impacts

Rice Straw diversion plan: [HYPERLINK "https://www.arb.ca.gov/smp/rice/riceplan/riceplan.htm"]

Other countries

The tables below (from Rosmiza, M.Z., 2014) shows the large number of potential uses for rice straw and the percentage of rice straw being used for various purposes in Bangladesh, Korea, Thailand, China, Japan, India, Taiwan, Philippines, Malaysia.

Agricultural sector	Manufacturing industries	Construction sector	Renewable energy
Compost	Paper making	Building material	Biofuel
Vermicompost	Food packaging	Thermal insulation	(ethanol)
Nursery mats	Activated carbon materials	Erosion control	Electricity
Mulching	Pyroligneous acid	Grass growth medium	Biogas
Mushroom growth medium		Land reclamation	(domestic uses)
Livestock feed			
Animal bedding			
Thatching			

Source: Park et al., 2014; Qian et al., 2014; Department of Science, Technology and Environment, 2013; Kanokkanjana & Garivait, 2013; Nguyen et al., 2013; Thapat & Gheewala, 2013; Delivand et al., 2012; Indian Agricultural Research Institute, 2012; Li et al., 2012; Liu et al., 2010; Lal, 2005; Devendra & Sevilla, 2002; MADA, 2004.

Table 3. Rice straw utilization in Asia countries

Country	Rice straw utilization	Percent (%)
Bangladesh	Livestock feed, compost, biogas	74.4
Korea	Compost	46.0
	Biofuel	20.0
	Livestock feed	15.0
Thailand	Livestock feed	13.0
	Compost	5.0
	Raw material (sell)	1.5
	Biofuel	0.2
	Others activities	0.3
China	Rural energy (electricity)	53.6
	Livestock feed	28.0
	Fertilizer	15.0
	Paper making	2.1
	Reused on the farm and collected for other purposes	16.2
Japan	Livestock feed	11.6
	Compost	10.1
	Animal bedding	6.5
	Combustion	4.6
	Erosion control	4.2
	Mulching	4.0
	Incinerator	3.1
	Handicraft	1.3
	Processed	1.1
	Other activities	0.3
India	Biogas	28.0
	Other activities (livestock feed and roof)	49.0
Taiwan	Compos	56.9
	Livestock feed	11.0
	Biofuel	5.1
	Other activities	22.1
Philippines	Livestock feed, mulching, mushroom growth medium	5.0
Malaysia	Livestock feed, compos, erosion control, mushroom growth medium, paper making	1.0

Source: Devendra, 1989; Gadde et al., 2009; MADA, 2010; Matsumura et al., 2005; Su, 2009; Lin et al., 2010; Devendra & Sevilla, 2002; Li et al., 2012

Resources/References (also see website links included in the above sections)

Agricultural Burn Program Websites:

Idaho Crop Residue Burning Program - [HYPERLINK "http://deq.idaho.gov/air-quality/burning/crop-residue-burning/"]
Washington - [HYPERLINK "https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/Agricultural-burning"]

Examples of permits and regulations:

Rules

Idaho: [HYPERLINK "https://adminrules.idaho.gov/rules/current/58/580101.pdf"]

Permits

FARR: [HYPERLINK "https://www.epa.gov/farr/tribal-burn-permit-programs-nez-perce-and-umatilla-indian-reservations" \l "ag-burn-permits"]

Washington: [HYPERLINK "https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/Agricultural-burning"]

Nez Perce Tribe (State of Idaho) [HYPERLINK "https://www.epa.gov/sites/production/files/2016-06/documents/farr-nezperce-ag-permit-application-06152016.pdf"]

Example State Permit Application

Example permit information for burning crop residue (e.g., spot burn, baled agricultural residue burn, propane flaming):

- Name and contact information
- Date and location of burn (plot plan)
- Duration of burn
- Crop type, acreage/piles, fuel characteristics of residue to be burned
- Preventive Measures: description of measures to prevent escaped burns, availability of water and plowed firebreaks

Example permit approval criteria (i.e., burn/no burn decisions)

- Permittee must get initial approval from State at least 12 hours in advance of burn
- Permittee must contact State to confirm approval the morning of the burn
- To approve burn, the State must determine that ambient air quality levels are not projected to exceed 90% of the ozone standard and a specified percentage of any other standard (e.g., 80% of an established "one-hour action criterium" for $PM_{2.5}$) over the next 24 hours
- All persons intending to burn crop residue shall attend a crop residue burning training session provided by the State, and a refresher training every five years

Other permit considerations

- Expected emissions from all burns proposed for same dates
- Proximity to other burns or emission sources within affected areas
- Moisture content of material to be burned
- Acreage, crop type, fuel characteristics
- Meteorology
    - Surface wind speed (>3mph, <15mph)
    - Surface wind direction (away from sensitive receptors)
    - Mixing Height (need profiles of atmospheric parameters from a remote- sensing system from ground to 1 mile or so)
    - Ventilation (or clearing) Index = wind speed * mixing height (poor, marginal, fair, good) [HYPERLINK "https://www.fs.fed.us/pnw/pubs/rp550/rp550b.pdf"]

    - Cloud Cover and relative humidity
    - Transport wind speed (7 to 20 mph)
- Proximity to Sensitive Populations (e.g., public schools, hospitals, residential health care facilities, and to public roadways and airports

Example burning prohibitions:
- No burning of crop residue on weekends, federal or state holidays, or after sunset or before sunrise
- Burning of crop residue only on State designated burn days
- No burning on days of Air Stagnation or Degraded Air Quality. All field burning prohibited when State issues an air quality forecast and caution, alert, warning or emergency

Example post-burn requirements:
- Report to the State: date burning was conducted, actual number and location of acres burned. (State may restrict further burning by a permittee until completed burns are reported)
- State must develop annual report that include an analysis of the causes of violations of permit provisions, assessment of reported endangerment to human health associated with a burn, and proposed revisions to State rules (with input from Advisory Committee)

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